1547687

Atlantic Richfield Company

Atlantic Richfield Company

4 Centerpointe Drive, 4-435
La Palma, CA 90623
Direct: (714) 228-6770

January 5, 2015

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Delivered via e-mail

Subject: December 2014 Monthly Progress Report
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01, Rico, Colorado

Dear Mr. Way,

This progress report describes activities conducted during the month of December, 2014 at the Rico-Argentine Mine Site (site) and activities anticipated to occur during the upcoming month. These activities are organized by task as identified in the Removal Action Work Plan. This progress report is being submitted in accordance with Paragraph 35.a of the Unilateral Administrative Order for Removal Action (the "UAO"), dated March 17, 2011 (effective March 23, 2011).

ACTIVITIES FOR DECEMBER

This section describes significant developments during the preceding period including actions performed and any problems encountered during this reporting period. A summary of the St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study system performance is provided as an attachment.

Site-Wide Activities

- Conducted Winter Avalanche and Winter Survival Training.
- Procured winter security observation for site.
- Completed an updated site topographic map of existing conditions (central/northern portions of site).
- Held conference call with EPA on December 15, 2014 to discuss a variety of topics, including:
  - Flume/flow data and instrumentation planned for 2015.
  - Public hearing with Dolores County on the Solids Repository.
  - Wetland water chemistry analytical tables and conceptual drawing.

Task A – Pre-Design and Ongoing Site Monitoring

- Performed additional evaluation of potential improvements on surface water flow data gathering and telemetry. Continued working with Town of Rico on the application for an antenna permit.
- Collected data and manual flow measurements from pressure transducers at DR-3 and DR-6.
- Downloaded flow measurement data from pressure transducers for Blaine Tunnel Flume.
- Inspected the St. Louis Ponds System, pond water levels, free-board, and condition of high-level outlet pipes and overflow spillways. The pond network appears to be flowing well and in good condition.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- Routed the St. Louis Tunnel discharge to Pond 18 during the month of December, 2014.
- Continued planning for removal of remaining mining/mineral processing by-products from Upper Ponds.

Task C – Design and Construction of a Solids Repository

- Held a public hearing with the Dolores County Planning Commission on December 22, 2014 in Dove Creek, CO to discuss and answer questions on the Solids Repository Land Use Application and Engineering Design and Operations Plan (EDOP). The Planning Commission voted unanimously to recommend approval of the Land Use Application by the Dolores County Board of County Commissioners (BOCC). The BOCC will consider the Planning Commission's recommendation and issue a final decision on the Land Use Application at a public hearing scheduled for February 17, 2015 at 10:30 am in Dove Creek, CO.

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- Continued design work on Stage 2 for the St. Louis Tunnel hydraulic control system.
- Monitored water levels in the tunnel at AT-2 using the data logger.
- Downloaded flow measurement data from pressure transducer at AT-2.

Task E – Source Water Investigations and Controls

- Continued Blaine Tunnel water depth and flow monitoring behind the Blaine Coffer Dam and Blaine Tunnel Flume and downloaded flow data.

Task F – Water Treatment System Analysis and Design

- Suspended routine site operations during the winter months as conditions make routine daily access to the site via wheeled vehicles difficult. Two sampling events occurred during the month of December 2014. Winter work is limited to essential activities only.

ACTIVITIES FOR UPCOMING MONTH

This section describes developments expected to occur during the upcoming reporting period, including a schedule of work to be performed, anticipated problems, and planned resolution of past or anticipated problems.

Site-Wide Activities

- Maintain winter access routes for sampling and monitoring of the Demonstration Wetland.
- Perform ongoing security observation of the site.
- Submit request to EPA for written confirmation of previously discussed UAO schedule modifications, including Tasks B2, C2, F2, F3, and F4.

Task A – Pre-Design and Ongoing Site Monitoring

- Initiate surface and groundwater sampling and monitoring for the winter low-flow sampling event.
- Inspect the St. Louis Ponds System, water levels, and free-board.
- Continue work on submittal and processing of the application for a telemetry antenna permit for the Rico office building.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- Continue routing St. Louis Tunnel discharge to Pond 18.

- Continue planning for removal of all remaining mining/mineral processing by-products from Upper Ponds.

Task C – Design and Construction of a Solids Repository

- Provide public notice of the February 17, 2015 public hearing with the Dolores County BOCC. Notice to be sent by mail, published in a local newspaper, and posted at the intersection of State Highway 145 and the site access road.

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- Continue work on design of Stage 2 hydraulic control measures.
- Monitor water levels in the tunnel at AT-2.

Task E – Source Water Investigations and Controls

- Continue Blaine Tunnel water depth and flow monitoring behind the Blaine Coffer Dam and Blaine Tunnel Flume.

Task F – Water Treatment System Analysis and Design

- Continue scoping additional data needs as necessary related to treatment system alternatives.
- Continue design of the Enhanced Wetland Demonstration System.
- Perform winter operations and sampling of the Demonstration Scale Wetlands twice per month, weather and site conditions permitting.

If you have any questions, please feel free to contact me at (951) 265-4277.

Sincerely,

Anthony R. Brown
Project Manager
Atlantic Richfield Company

cc: R. Halsey, Atlantic Richfield
T. Moore, Atlantic Richfield
C. Harris, Atlantic Richfield
R. Raftery, Esq., Atlantic Richfield
C. Sanchez, Anderson Engineering
D. Yadon, AECOM
J. Christner, Weston Solutions
S. Riese, EnSci
A. Cohen, Esq., Davis Graham & Stubbs
W. Duffy, Esq., Davis Graham & Stubbs
A. Piggott, Esq., U.S. EPA
D. McCarthy, Copper Environmental
K. Sessions, AEEC
B. Wheeler, AEEC
B. Florentin, AMEC

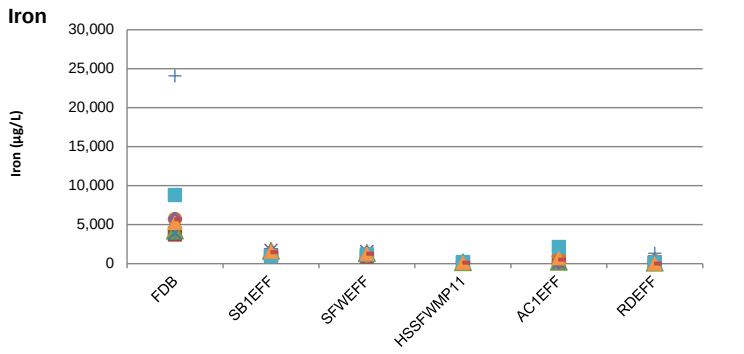
file: Atlantic Richfield Rico Archives, La Palma, CA
AECOM Denver Project File

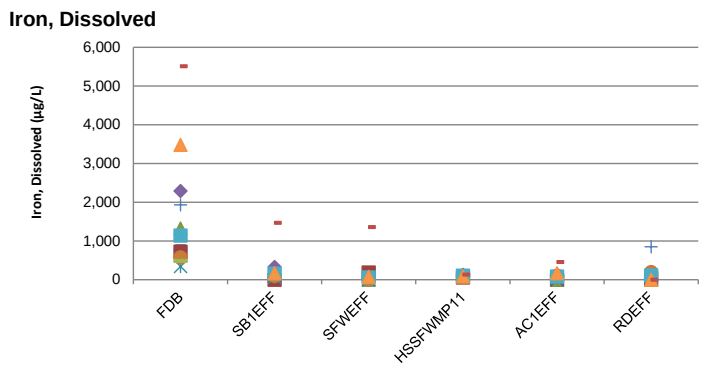
Attachment

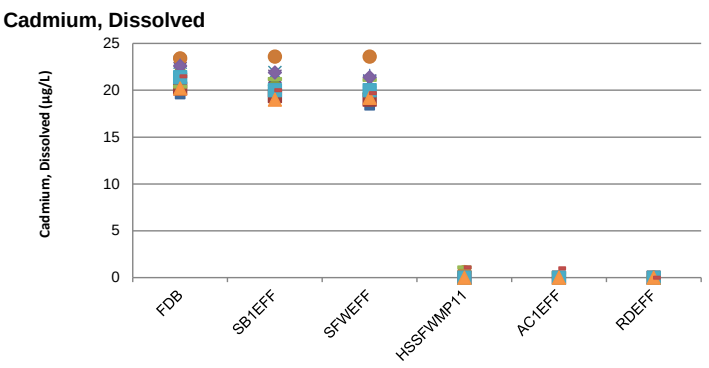
Key Performance Indicators Figures

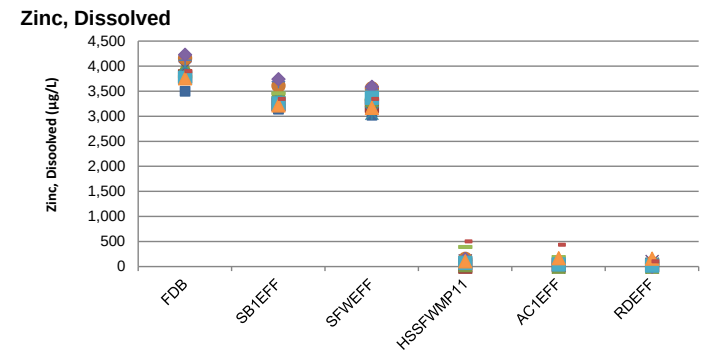
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

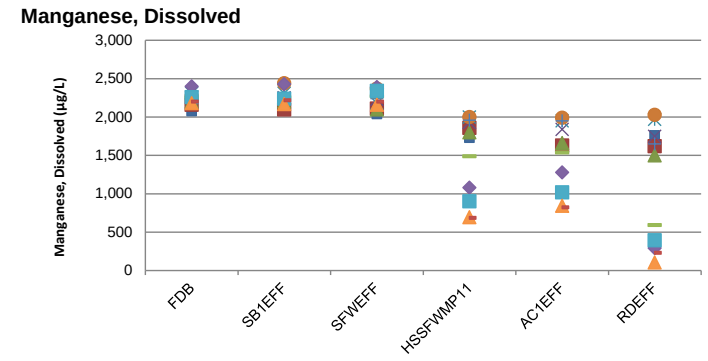
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

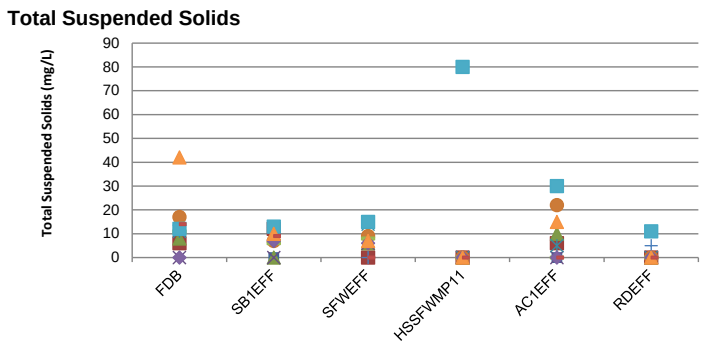


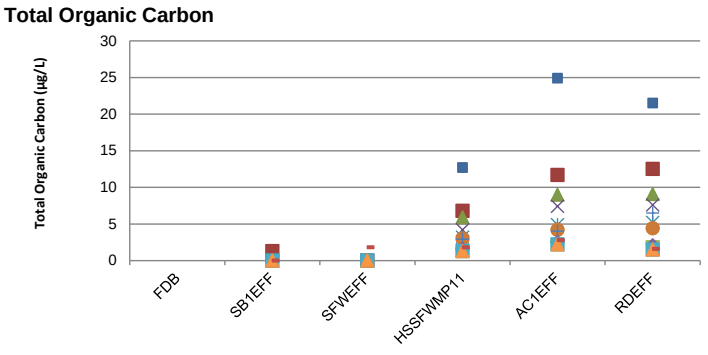


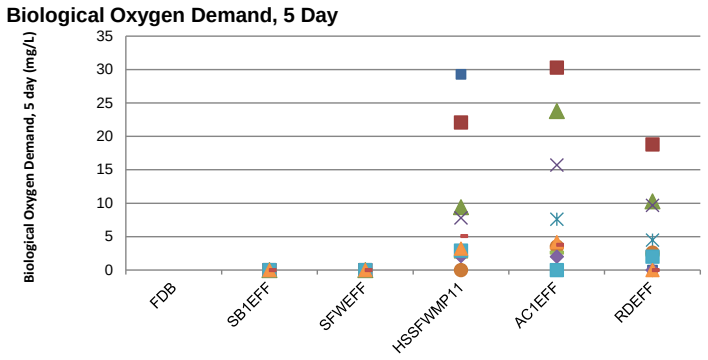


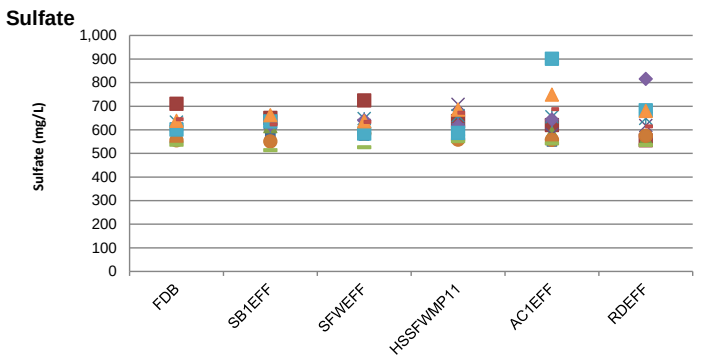


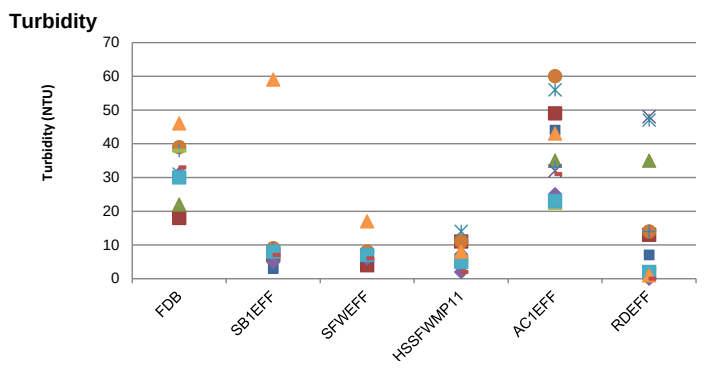


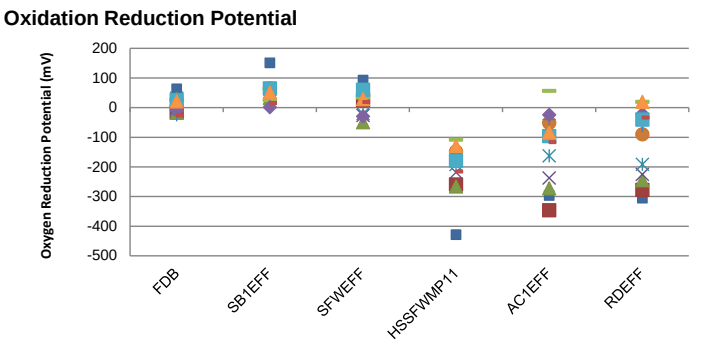


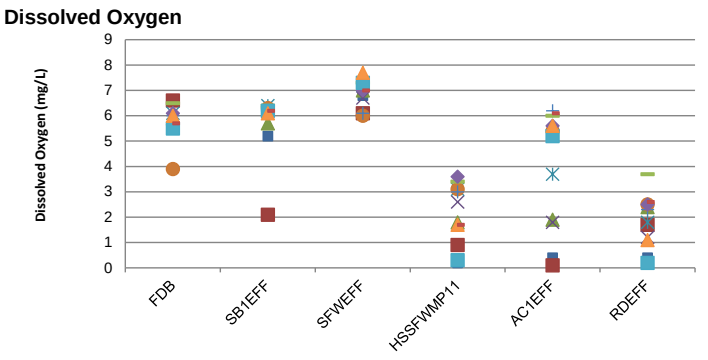


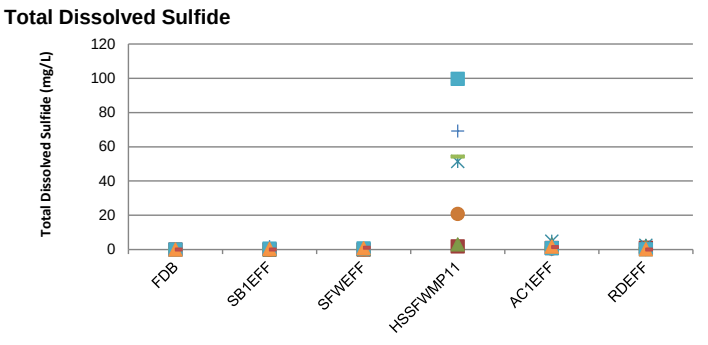


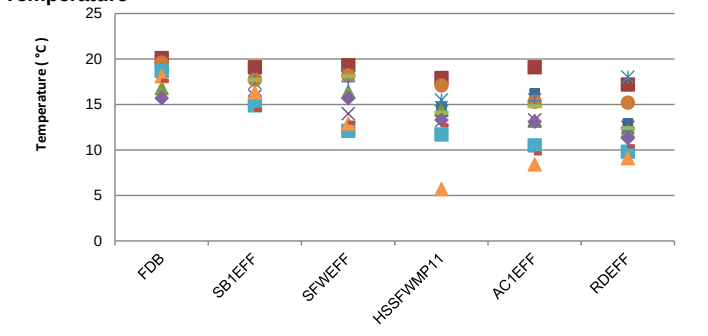












Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

The interpolation method for calculating flow rates for both the horizontal and vertical treatment trains was adjusted to better represent what is happening on a weekly basis.

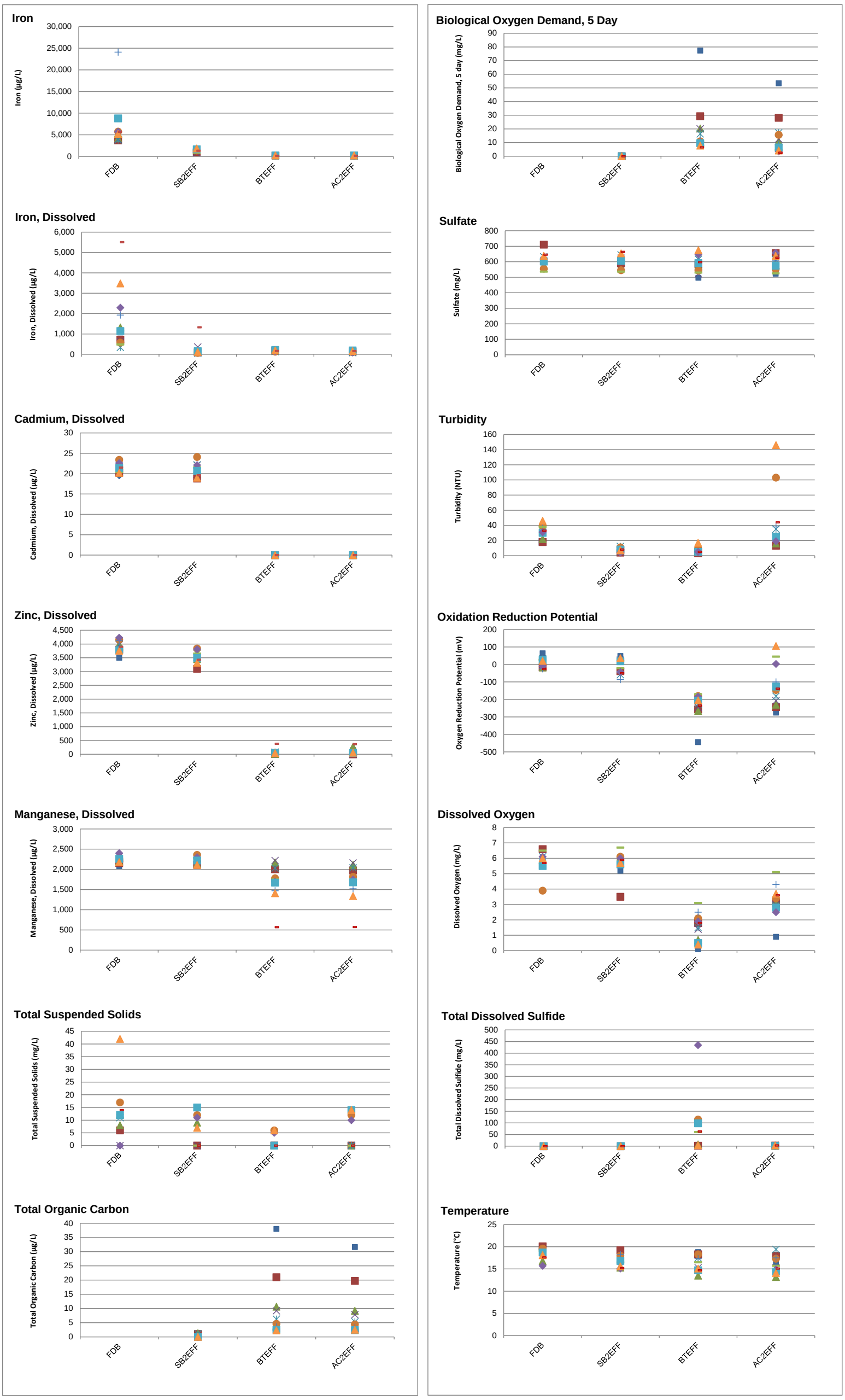
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
RDEFF = Rock Drain Effluent
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

°C = Degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RL = Reporting Limit
C W** = Colinization Week of Treatability Study Phase

C W00, 25.8 gpm C W01, 30.7 gpm C W02, 29.5 gpm C W03, 30.2 gpm
C W04, 26.8 gpm C W05, 29.2 gpm C W06, 27.7 gpm C W07, 28.8 gpm
C W08, 27.9 gpm C W09, 27.9 gpm C W10, 27.0 gpm C W12, 25.5 gpm

FIGURE 1
HWTT Key Performance Indicators Spatial Series
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

1/2/2015



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Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

The interpolation method for calculating flow rates for both the horizontal and vertical treatment trains was adjusted to better represent what is happening on a weekly basis.

The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

°C = Degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RL = Reporting Limit
C W** = Colinization Week of Treatability Study Phase

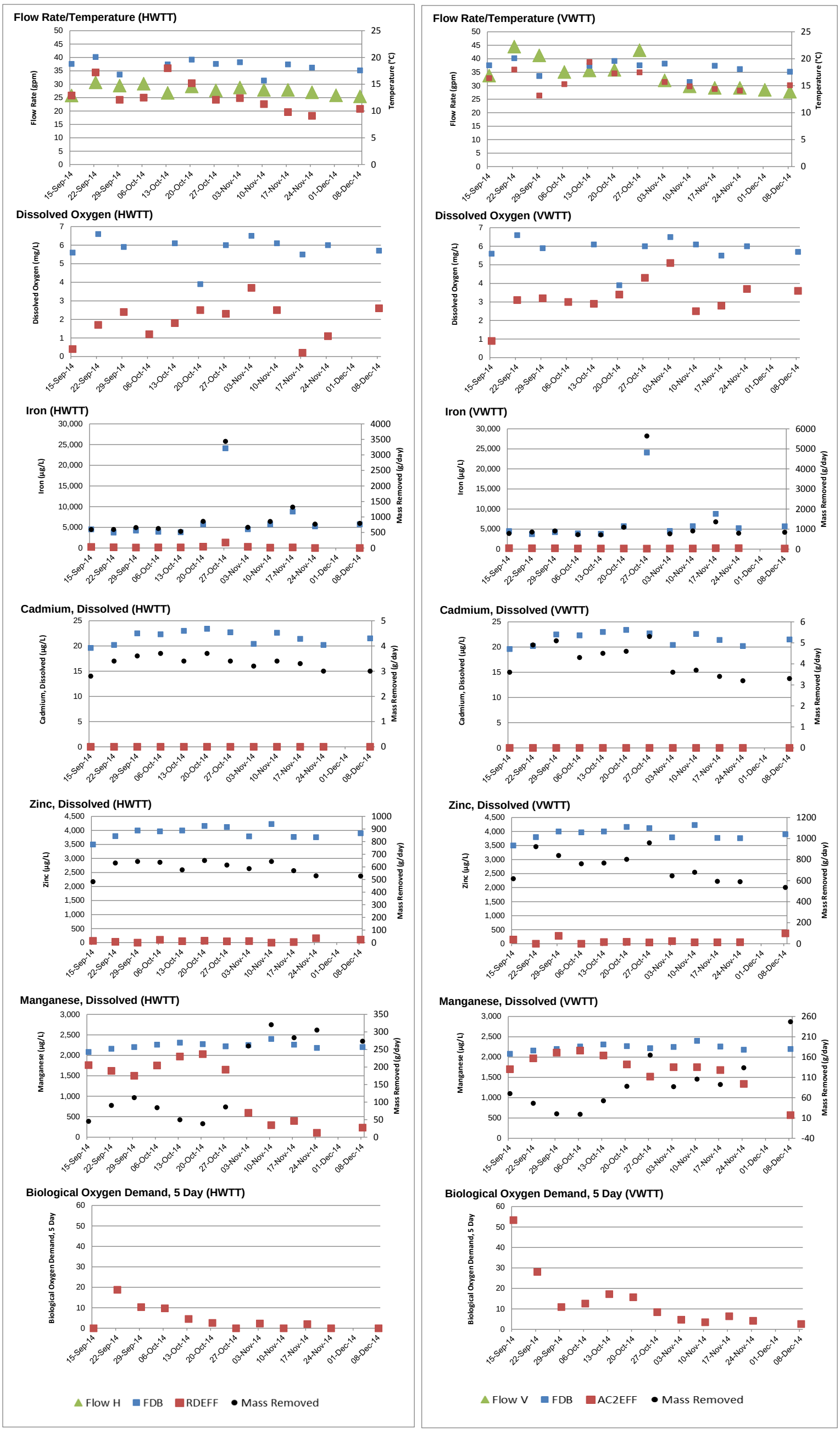
FIGURE 2

VWTT Key Performance Indicators Spatial Series

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

1/2/2015



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Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

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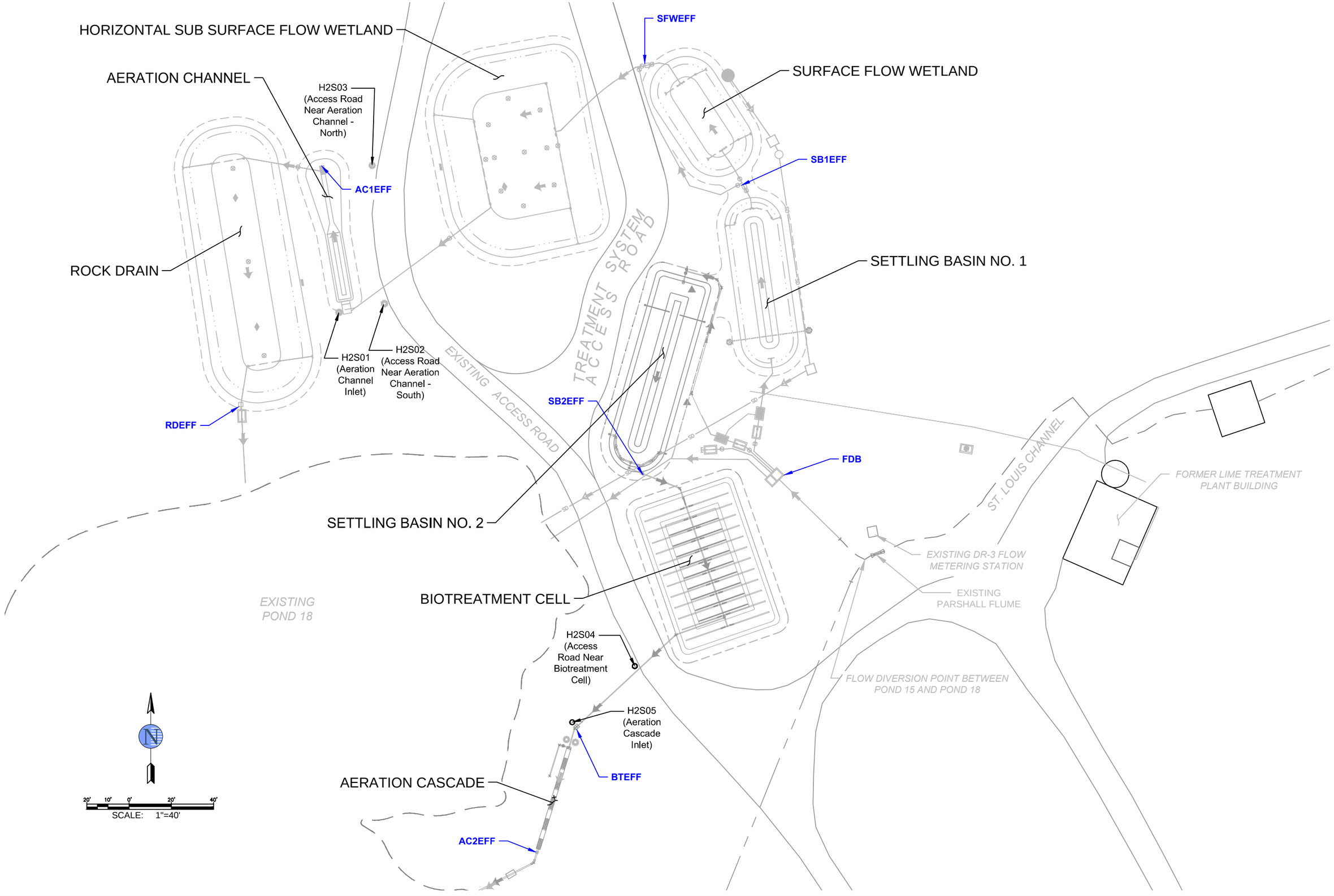
AC2EFF = Aeration Cascade Effluent
°C = Degrees Celsius
µg/L = micrograms per liter
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
gpm = gallons per minute
g/day = grams per day
HWTT = Horizontal Wetland Treatment Train
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
RDEFF = Rock Drain Effluent
RL = Reporting Limit
VWTT = Vertical Wetland Treatment Train

FIGURE 3

HWTT/VWTT Key Performance Indicators Time Series

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01



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CHECKED:	LPCjr
REVIEWED:	KS
APPROVED:	KS
JOB No:	1300
CAD FILE:	Figure 4.dwg

DESCRIPTION | DATE | REV

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

RICO - ARGENTINE MINE SITE
ST LOUIS DISCHARGE CWDTS

Monthly Progress Report
Monitoring Locations

AEEC
www.americanconsultants.com
3489 W 2100 S, Salt Lake City, UT 84119
801-908-5447 Fax 801-972-2741

DATE:	01 DEC 14
SCALE:	1:40
SHEET:	01 OF 01

Figure 4

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Key Performance Indicators Tables

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Table 1. Iron (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	4500	1330	1200	223	261	250	1250	266	246
C	W01	22-Sep-14	30.7	44.5	3740	1070	930	168	203	170	971	206	218
C	W02	29-Sep-14	29.5	41.3	4230	1640	1360	194	250	129	1440	216	210
C	W03	06-Oct-14	30.2	35.1	3940	1720	1540	142	156	134	937	171	165
C	W04	13-Oct-14	26.8	35.7	3820	892	900	146	138	144	1500	161	154
C	W05	20-Oct-14	29.2	35.9	5730	1260	1010	133	1010	326	1390	244	143
C	W06	27-Oct-14	27.7	43.2	24100	1630	1330	171	304	1340	R	157	137
C	W07	03-Nov-14	28.8	32.0	4550	1180	1130	126	118	297	902	175	153
C	W08	10-Nov-14	27.9	29.8	5720	1540	1380	137	115	99.6	1640	151	148
C	W09	17-Nov-14	27.9	29.2	8800	978	1190	218	2140	141	1670	253	260
C	W10	24-Nov-14	27.0	29.2	5230	1550	1270	135	712	<50	1850	236	245
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	5710	1490	1280	129	538	<50	1320	164	156

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = horizontal treatment train average flow rate
Flow V = vertical treatment train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NS = not sampled
OU = operable unit
RDEFF = Rock Drain Effluent
R = rejected
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
µg/L = microgram per liter
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 2. Iron, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	772	56.4	<50	80.7	50.8	76.2	101	213	174
C	W01	22-Sep-14	30.7	44.5	723	<50	182	56	<50	<50	96.2	172	128
C	W02	29-Sep-14	29.5	41.3	1320	140	<50	74.1	<50	<50	166	189	147
C	W03	06-Oct-14	30.2	35.1	625	120	<50	79.8	<50	53.3	360	147	86.2
C	W04	13-Oct-14	26.8	35.7	339	58.2	<50	77	52.8	66.1	67	135	89.4
C	W05	20-Oct-14	29.2	35.9	575	96	<50	78.9	103	195	72.8	128	106
C	W06	27-Oct-14	27.7	43.2	1930	252	64.6	123	113	847	R	140	113
C	W07	03-Nov-14	28.8	32.0	483	113	59.9	122	80.5	148	66.4	143	106
C	W08	10-Nov-14	27.9	29.8	2290	329	67.6	126	64.4	79.8	147	134	90
C	W09	17-Nov-14	27.9	29.2	1140	152	54.6	101	79.2	111	154	215	188
C	W10	24-Nov-14	27.0	29.2	3480	167	73.4	85.4	168	<50	119	194	163
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	5510	1470	1360	130	454	<50	1330	167	161

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

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[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 3. Cadmium, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	19.6	18.9	18.4	<0.5	<0.5	<0.5	19.1	<0.5	<0.5
C	W01	22-Sep-14	30.7	44.5	20.2	19.4	19	<0.5	<0.5	<0.5	18.8	<0.5	<0.5
C	W02	29-Sep-14	29.5	41.3	22.5	21.2	20.4	<0.5	<0.5	<0.5	21.2	<0.5	<0.5
C	W03	06-Oct-14	30.2	35.1	22.3	21.5	21	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W04	13-Oct-14	26.8	35.7	23	21.9	20.7	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W05	20-Oct-14	29.2	35.9	23.4	23.6	23.6	0.6	<0.5	<0.5	24.1	<0.5	<0.5
C	W06	27-Oct-14	27.7	43.2	22.7	21.9	21.6	<0.5	<0.5	<0.5	R	<0.5	<0.5
C	W07	03-Nov-14	28.8	32.0	20.4	21.2	21.1	1.1	0.51	<0.5	21.6	<0.5	<0.5
C	W08	10-Nov-14	27.9	29.8	22.6	21.9	21.4	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W09	17-Nov-14	27.9	29.2	21.4	20	20	<0.5	<0.5	<0.5	20.7	<0.5	<0.5
C	W10	24-Nov-14	27.0	29.2	20.2	19	19.2	<0.5	<0.5	<0.5	19	<0.5	<0.5
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	21.5	20	19.7	1.1	1	<0.5	19.6	<0.5	<0.5

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = horizontal treatment train average flow rate
Flow V = vertical treatment train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NS = not sampled
OU = operable unit
R = rejected
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
µg/L = microgram per liter
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 4. Zinc, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	3500	3140	3020	60.6	<10	62.5	3120	52 J	148
C	W01	22-Sep-14	30.7	44.5	3800 J	3240	3210	<10	27	30	3100	12.8	<10
C	W02	29-Sep-14	29.5	41.3	4000	3520	3320	30.3	<10	<10	3450 J	10.8	279
C	W03	06-Oct-14	30.2	35.1	3970	3570	3440	115	37.9	102	3530	32.7	<10
C	W04	13-Oct-14	26.8	35.7	4000	3360	3060	90.4	60.5	53	3650	76.2	59.4
C	W05	20-Oct-14	29.2	35.9	4160	3610	3560	156	70	69.3	3840	56.4	65.7
C	W06	27-Oct-14	27.7	43.2	4120	3690	3530	79.9	47.8	47.9	R	<10	46.9
C	W07	03-Nov-14	28.8	32.0	3790	3460	3340	391	190	54	3650	83.3	91.7
C	W08	10-Nov-14	27.9	29.8	4230	3740	3590	152	48.3	<10	3810	15.2	49.4
C	W09	17-Nov-14	27.9	29.2	3770	3260	3370	74	44.1	23.5	3500	50.5	48.8
C	W10	24-Nov-14	27.0	29.2	3760	3220	3170	105	168	159	3320	41.8	54.5
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	3900	3350	3350	503	439	106	3430	380	368

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 5. Manganese, Dissolved (µg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	2080	2100	2040 J	1730 J	1610	1760	2110	1690	1700
C	W01	22-Sep-14	30.7	44.5	2160 J	2100	2110	1860 J	1630	1620	2110	2000	1970
C	W02	29-Sep-14	29.5	41.3	2200	2200	2100	1800	1660	1500	2140 J	2170 J	2110
C	W03	06-Oct-14	30.2	35.1	2260	2250	2230	1930	1840	1750 J	2280	2220 J	2160
C	W04	13-Oct-14	26.8	35.7	2310 B	2310 B	2180 B	2000 B	1950 B	1970 B	2310 B	2030 B	2040 B
C	W05	20-Oct-14	29.2	35.9	2270	2440	2370	2000 J	1990	2030	2360	1780	1820
C	W06	27-Oct-14	27.7	43.2	2220	2300	2240	1960	1950	1650 J	R	1470	1520
C	W07	03-Nov-14	28.8	32.0	2250	2260	2270	1490	1540	594 J	2270	1750	1750
C	W08	10-Nov-14	27.9	29.8	2400	2430	2390	1080	1280	293 J	2300 J	1690 J	1750
C	W09	17-Nov-14	27.9	29.2	2260	2240	2340	904 J	1020	396 J	2220	1670	1680
C	W10	24-Nov-14	27.0	29.2	2180	2170	2160	695 J	843	106 J	2110	1410	1340
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	2200	2220	2200	686	825	232	2200	568	571

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

B = Laboratory flag indicating blank contamination

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

µg/L = microgram per liter

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 6. Total Suspended Solids (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	6	<5	<5	<5	<5	<5	<5	<5	<5
C	W01	22-Sep-14	30.7	44.5	6	12	<5	<5	6	<5	<5	<5	<5
C	W02	29-Sep-14	29.5	41.3	8	<5	6	<5	10	<5	9	<5	<5
C	W03	06-Oct-14	30.2	35.1	<5	<5	6	<5	<5	<5	<5	<5	<5
C	W04	13-Oct-14	26.8	35.7	11	10	14	<5	5	<5	15	<5	<5
C	W05	20-Oct-14	29.2	35.9	17	7	9	<5	22	<5	12	6	12
C	W06	27-Oct-14	27.7	43.2	<5	7	<5	<5	<5	5	R	<5	<5
C	W07	03-Nov-14	28.8	32.0	11	6	8	<5	<5	<5	<5	<5	<5
C	W08	10-Nov-14	27.9	29.8	<5	7	6	<5	<5	<5	11	5	10
C	W09	17-Nov-14	27.9	29.2	12	13	15	80	30	11	15	<5	14
C	W10	24-Nov-14	27.0	29.2	42	10	7	<5	15	<5	7	6	14
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	14	9	<5	<5	<5	<5	<5	<5	<5

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 7. Total Organic Carbon (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	NR	<1	<1	12.7	24.9	21.5	<1	38	31.6
C	W01	22-Sep-14	30.7	44.5	NR	1.3	<1	6.8	11.7	12.5	1	21	19.7
C	W02	29-Sep-14	29.5	41.3	NR	<1	<1	5.9	9	9.1	1.3	10.6	9.2
C	W03	06-Oct-14	30.2	35.1	NR	<1	<1	4.2	7.4	7.6	<1	9.2	7.8
C	W04	13-Oct-14	26.8	35.7	NR	<1	<1	3.2	4.9	5.2	1.1	6.2 J	5.3
C	W05	20-Oct-14	29.2	35.9	NR	<1	<1	3	4.2	4.4	<1	4.6	4.4
C	W06	27-Oct-14	27.7	43.2	NR	<1	<1	2.9	4	6.5	R	3.5	3.3
C	W07	03-Nov-14	28.8	32.0	NR	<1	<1	1.6	2.6	2.5	<1	2.6	2.6
C	W08	10-Nov-14	27.9	29.8	NR	<1	<1	1.6	2.5	2.1	<1	2.4	2.4
C	W09	17-Nov-14	27.9	29.2	NR	<1	<1	1.7	2.5	2	<1	2.5	2.4
C	W10	24-Nov-14	27.0	29.2	NR	<1	<1	1.3	2.2	1.5	<1	2.3	2.5
C	W11	01-Dec-14	25.9	28.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	NR	<1	1.8	1.8	2.8	1.6	<1	2	1.9

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

mg/L = milligram per liter

NR = not required

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 8. Biological Oxygen Demand, 5 day (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	NR	<2	<2	29.3	R	R	<2	77.4	53.4
C	W01	22-Sep-14	30.7	44.5	NR	<2	<2	22.1	30.3	18.8	<2	29.3	28.1
C	W02	29-Sep-14	29.5	41.3	NR	<2	<2	9.4	23.8	10.3	<2	20.3	10.9
C	W03	06-Oct-14	30.2	35.1	NR	<2	<2	7.8	15.7	9.7	<2	20.1	12.6
C	W04	13-Oct-14	26.8	35.7	NR	<2	<2	2.8	7.6	4.5	<2	16.4	17.2
C	W05	20-Oct-14	29.2	35.9	NR	<2	<2	<2	3.5	2.6	<2	10.9	15.7
C	W06	27-Oct-14	27.7	43.2	NR	<2	<2	3.1	2	<2	<2	11.5	8.4
C	W07	03-Nov-14	28.8	32.0	NR	<2	<2	2	2.6	2.3	<2	8	4.7
C	W08	10-Nov-14	27.9	29.8	NR	<2	<2	2.1	2	<2	<2	9.7	3.5
C	W09	17-Nov-14	27.9	29.2	NR	<2	<2	2.9	<2	2	<2	9.6	6.4
C	W10	24-Nov-14	27.0	29.2	NR	<2	<2	3.2	4.2	<2	<2	7.8	4.2
C	W11	01-Dec-14	25.9	28.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	NR	<2	<2	5.1	3.8	<2	<2	6.5	2.6

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
mg/L = milligram per liter
NR = not requrired
NS = not sampled
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 9. Sulfate (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	595	579	575	603	551	571	571	497	523
C	W01	22-Sep-14	30.7	44.5	710	650	724	637	620	555 J	589	582	656
C	W02	29-Sep-14	29.5	41.3	574	615	612	605	587	565	613	573	580 J
C	W03	06-Oct-14	30.2	35.1	570	630	618	707	580	618	622	522	562
C	W04	13-Oct-14	26.8	35.7	632	637	647	660	655	648	644	615 J	612
C	W05	20-Oct-14	29.2	35.9	555	551	584	558	557	574	545	543	552
C	W06	27-Oct-14	27.7	43.2	629	614	596	625	637	673	R	602	606
C	W07	03-Nov-14	28.8	32.0	536	514	526	552	542	535	536	530	525
C	W08	10-Nov-14	27.9	29.8	616	623	640	617	644	815	627	646	657
C	W09	17-Nov-14	27.9	29.2	601	635	584	587 J	901	683	606	591	574
C	W10	24-Nov-14	27.0	29.2	638	662	636	685	749	680	654	674	638
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	645	623	633	672	687	614	663	597	625

NOTES:

Non detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Evironment Water Quality Control Comission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.

mg/L = milligram per liter

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 10. Turbidity (NTU)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	18	3	5	R	44	7	8	R	R
C	W01	22-Sep-14	30.7	44.5	18	7	4	11	49	13	4	3	13
C	W02	29-Sep-14	29.5	41.3	22	8	7	8	35	35	7	7	16
C	W03	06-Oct-14	30.2	35.1	NM	7	6	9	32	48	5	6	26
C	W04	13-Oct-14	26.8	35.7	31	8	7	14	56	47	12	7	35
C	W05	20-Oct-14	29.2	35.9	39	9	8	11	60	14	11	9	103
C	W06	27-Oct-14	27.7	43.2	38	9	6	7	33	14	5	5	38
C	W07	03-Nov-14	28.8	32.0	38	9	8	5	21	3	6	3	28
C	W08	10-Nov-14	27.9	29.8	31	5	6	2	25	0	4	5	19
C	W09	17-Nov-14	27.9	29.2	30	8	7	5	23	2	8	5	25
C	W10	24-Nov-14	27.0	29.2	46	59	17	8	43	1	7	17	146
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	33	7	6	2	31	0	8	5	44

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NM = not measured

NTU = Nephelometric Turbidity Units

OU = operable unit

R = Rejected

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 11. ORP (millivolts)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	64	151	93	-428	-296	-305	49	-444	-275
C	W01	22-Sep-14	30.7	44.5	-16	R	24	-259	-346	-277	-38	-257	-243
C	W02	29-Sep-14	29.5	41.3	-17	33	-49	-266	-272	-245	23	-265	-230
C	W03	06-Oct-14	30.2	35.1	NM	46	-26	-218	-237	-225	25	-244	-207
C	W04	13-Oct-14	26.8	35.7	32	54	-20	-192	-162	-191	-58	-226	-182
C	W05	20-Oct-14	29.2	35.9	27	65	45	-148	-51	-90	22	-180	-146
C	W06	27-Oct-14	27.7	43.2	-24	41	36	-160	-40	-60	-86	-203	-100
C	W07	03-Nov-14	28.8	32.0	27	26	34	-108	57	20	-21	-170	45
C	W08	10-Nov-14	27.9	29.8	-10	2	-29	-161	-24	-21	-43	-184	3
C	W09	17-Nov-14	27.9	29.2	26	65	61	-179	-96	-40	19	-207	-126
C	W10	24-Nov-14	27.0	29.2	21	51	29	-129	-84	20	36	-205	106
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	-26	16	19	-215	-116	-33	-49	-235	-138

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
mV = millivolts
NM = not measured
ORP = Oxidation Reduction Potential
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 12. Dissolved Oxygen (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	5.6	5.2	6.8	0.2	0.4	0.4	5.2	0.1	0.9
C	W01	22-Sep-14	30.7	44.5	6.6	2.1	6.1	0.9	0.1	1.7	3.5	1.8	3.1
C	W02	29-Sep-14	29.5	41.3	5.9	5.7	7	1.8	1.9	2.4	6.1	0.7	3.2
C	W03	06-Oct-14	30.2	35.1	NM	6.1	6.7	2.6	1.8	1.2	5.9	1.4	3
C	W04	13-Oct-14	26.8	35.7	6.1	6.4	7.2	3.1	3.7	1.8	5.9	1.5	2.9
C	W05	20-Oct-14	29.2	35.9	3.9	6.3	6	3.1	5.4	2.5	6.1	2.1	3.4
C	W06	27-Oct-14	27.7	43.2	6	6.2	6.1	3	6.2	2.3	6	2.5	4.3
C	W07	03-Nov-14	28.8	32.0	ns	6.4	7.3	3.4	6	3.7	6.7	3.1	5.1
C	W08	10-Nov-14	27.9	29.8	6.1	6.2	7	3.6	5.6	2.5	6	1.9	2.5
C	W09	17-Nov-14	27.9	29.2	5.5	6.2	7.3	0.3	5.2	0.2	5.6	0.5	2.8
C	W10	24-Nov-14	27.0	29.2	6	6.1	7.7	1.7	5.6	1.1	5.7	0.4	3.7
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	5.7	6.2	7	1.7	6.1	2.6	5.9	1.8	3.6

NOTES:
Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
mg/L = milligram per liter
NM = not measured
OU = operable unit
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 13. Total Dissolved Sulfide (mg/L)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	R	R	R	R	R	R	R	R	R
C	W01	22-Sep-14	30.7	44.5	0	0	0	1.87	0.98	1.05	0.02	1.8	2.66
C	W02	29-Sep-14	29.5	41.3	NM	0.12	0.25	3.03	3.13	2.2	0.11	7.99	1.43
C	W03	06-Oct-14	30.2	35.1	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W04	13-Oct-14	26.8	35.7	0	0.02	0.06	51.46	4.9	2.5	0.07	R	3.67
C	W05	20-Oct-14	29.2	35.9	0.11	0.03	0.11	20.82	0.61	0.51	0.24	114.7	1.37
C	W06	27-Oct-14	27.7	43.2	0	1.77	0.56	69.24	0.05	0.09	1.88	R	3.07
C	W07	03-Nov-14	28.8	32.0	0.02	0.36	1.19	54.32	1.16	0.47	0.34	61.11	0.53
C	W08	10-Nov-14	27.9	29.8	NM	NM	NM	NM	NM	NM	0.14	434.4	0.48
C	W09	17-Nov-14	27.9	29.2	0	0.63	0.67	99.72	0.89	0.22	0.19	98.46	0.97
C	W10	24-Nov-14	27.0	29.2	0	0.39	0.88	R	1.75	0.19	0.1	4.1	3.27
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	0	0.01	1.1	R	1.46	0.06	0	62.93	3.2

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NM = not measured
mg/L = milligram per liter
OU = operable unit
R = Rejected
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 14. Temperature (degrees Celcius)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H[1] (gpm)	FLOW V[1,2] (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	18.8	18.1	18.8	14.7	16.2	12.9	18.6	18.8	16.4
C	W01	22-Sep-14	30.7	44.5	20.1	19.1	19.3	17.9	19.1	17.2	19.2	18.3	18
C	W02	29-Sep-14	29.5	41.3	16.8	15.5	16.4	14.4	13.2	12.1	15.3	13.5	13.2
C	W03	06-Oct-14	30.2	35.1	NM	15.9	14	13.2	13.3	12.5	15.5	15.3	15.3
C	W04	13-Oct-14	26.8	35.7	18.7	17.4	18.3	15.5	15.5	18	17.5	17.5	19.4
C	W05	20-Oct-14	29.2	35.9	19.6	17.7	18.2	17.1	15.3	15.2	18	18.3	17.3
C	W06	27-Oct-14	27.7	43.2	18.8	17.7	17.5	15.3	15.4	12.1	18.3	17.3	17.5
C	W07	03-Nov-14	28.8	32.0	19.1	17.7	18.1	14.1	14.8	12.4	16.5	16.5	15.7
C	W08	10-Nov-14	27.9	29.8	15.7	15.9	15.7	13.3	13.1	11.3	15.1	14.7	14.9
C	W09	17-Nov-14	27.9	29.2	18.7	14.9	12.1	11.7	10.5	9.8	16.8	14.7	14.4
C	W10	24-Nov-14	27.0	29.2	18.1	16.3	12.9	5.7	8.4	9.1	15.6	15.1	14.1
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	17.6	14.4	13	12.7	9.6	10.4	15.2	14.7	15.1

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
DEG C = degrees celcius
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
Flow H = Horizontal Treatment Train average flow rate
Flow V = Vertical Treatment Train average flow rate
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
NM = not measured
OU = operable unit
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

[1] The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

[2] The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 15. Mass Removal
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Cadmium, Dissolved	19.6	<0.5	19.6	25.8	259,600	100	2.8	<0.5	19.6	33.8	340200	100	3.6
C	W01	22-Sep-14	Cadmium, Dissolved	20.2	<0.5	20.2	30.7	309,600	100	3.4	<0.5	20.2	44.5	448200	100	4.9
C	W02	29-Sep-14	Cadmium, Dissolved	22.5	<0.5	22.5	29.5	297,200	100	3.6	<0.5	22.5	41.3	416100	100	5.1
C	W03	06-Oct-14	Cadmium, Dissolved	22.3	<0.5	22.3	30.2	304,500	100	3.7	<0.5	22.3	35.1	353800	100	4.3
C	W04	13-Oct-14	Cadmium, Dissolved	23	<0.5	23	26.8	270,000	100	3.4	<0.5	23	35.7	359700	100	4.5
C	W05	20-Oct-14	Cadmium, Dissolved	23.4	<0.5	23.4	29.2	294,600	100	3.7	<0.5	23.4	35.9	361600	100	4.6
C	W06	27-Oct-14	Cadmium, Dissolved	22.7	<0.5	22.7	27.7	278,800	100	3.4	<0.5	22.7	43.2	435500	100	5.3
C	W07	03-Nov-14	Cadmium, Dissolved	20.4	<0.5	20.4	28.8	290,300	100	3.2	<0.5	20.4	32	322600	100	3.6
C	W08	10-Nov-14	Cadmium, Dissolved	22.6	<0.5	22.6	27.9	280,900	100	3.4	<0.5	22.6	29.8	300300	100	3.7
C	W09	17-Nov-14	Cadmium, Dissolved	21.4	<0.5	21.4	27.9	281,100	100	3.3	<0.5	21.4	29.2	294300	100	3.4
C	W10	24-Nov-14	Cadmium, Dissolved	20.2	<0.5	20.2	27.0	271,700	100	3	<0.5	20.2	29.2	294300	100	3.2
C	W11	01-Dec-14	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Cadmium, Dissolved	21.5	<0.5	21.5	25.5	257,200	100	3	<0.5	21.5	27.8	279900	100	3.3
C	W00	15-Sep-14	Iron	4500	250	4250	25.8	259,600	94.4	597.7	246	4254	33.8	340200	94.5	783.8
C	W01	22-Sep-14	Iron	3740	170	3570	30.7	309,600	95.5	597.4	218	3522	44.5	448200	94.2	854.3
C	W02	29-Sep-14	Iron	4230	129	4101	29.5	297,200	97	659.5	210	4020	41.3	416100	95	905
C	W03	06-Oct-14	Iron	3940	134	3806	30.2	304,500	96.6	626.5	165	3775	35.1	353800	95.8	722.3
C	W04	13-Oct-14	Iron	3820	144	3676	26.8	270,000	96.2	537	154	3666	35.7	359700	96	713.4
C	W05	20-Oct-14	Iron	5730	326	5404	29.2	294,600	94.3	860.1	143	5587	35.9	361600	97.5	1093.3
C	W06	27-Oct-14	Iron	24100	1340	22760	27.7	278,800	94.4	3436.6	137	23963	43.2	435500	99.4	5642.9
C	W07	03-Nov-14	Iron	4550	297	4253	28.8	290,300	93.5	667.7	153	4397	32	322600	96.6	767
C	W08	10-Nov-14	Iron	5720	99.6	5620.4	27.9	280,900	98.3	854.8	148	5572	29.8	300300	97.4	905.1
C	W09	17-Nov-14	Iron	8800	141	8659	27.9	281,100	98.4	1316.9	260	8540	29.2	294300	97	1359.3
C	W10	24-Nov-14	Iron	5230	<50	5230	27.0	271,700	100	769.7	245	4985	29.2	294300	95.3	793.5
C	W11	01-Dec-14	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Iron	5710	<50	5710	25.5	257,200	100	793.7	156	5554	27.8	279900	97.3	841.6
C	W00	15-Sep-14	Iron, Dissolved	772	76.2	695.8	25.8	259,600	90.1	97.9	174	598	33.8	340200	77.5	110.2
C	W01	22-Sep-14	Iron, Dissolved	723	<50	723	30.7	309,600	100	121	128	595	44.5	448200	82.3	144.3
C	W02	29-Sep-14	Iron, Dissolved	1320	<50	1320	29.5	297,200	100	212.3	147	1173	41.3	416100	88.9	264.1
C	W03	06-Oct-14	Iron, Dissolved	625	53.3	571.7	30.2	304,500	91.5	94.1	86.2	538.8	35.1	353800	86.2	103.1
C	W04	13-Oct-14	Iron, Dissolved	339	66.1	272.9	26.8	270,000	80.5	39.9	89.4	249.6	35.7	359700	73.6	48.6
C	W05	20-Oct-14	Iron, Dissolved	575	195	380	29.2	294,600	66.1	60.5	106	469	35.9	361600	81.6	91.8
C	W06	27-Oct-14	Iron, Dissolved	1930	847	1083	27.7	278,800	56.1	163.5	113	1817	43.2	435500	94.1	427.9
C	W07	03-Nov-14	Iron, Dissolved	483	148	335	28.8	290,300	69.4	52.6	106	377	32	322600	78.1	65.8
C	W07	03-Nov-14	Iron, Dissolved	2290	79.8	2210.2	27.9	280,900	96.5	336.1	90	2200	29.8	300300	96.1	357.4
C	W09	17-Nov-14	Iron, Dissolved	1140	111	1029	27.9	281,100	90.3	156.5	188	952	29.2	294300	83.5	151.5
C	W10	24-Nov-14	Iron, Dissolved	3480	<50	3480	27.0	271,700	100	512.2	163	3317	29.2	294300	95.3	528
C	W11	01-Dec-14	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Iron, Dissolved	5510	<50	5510	25.5	257,200	100	765.9	161	5349	27.8	279900	97.1	810.6
C	W00	15-Sep-14	Manganese, Dissolved	2080	1760	320	25.8	259,600	15.4	45	1700	380	33.8	340200	18.3	70
C	W01	22-Sep-14	Manganese, Dissolved	2160 J	1620	540	30.7	309,600	25	90.4	1970	190	44.5	448200	8.8	46.1
C	W02	29-Sep-14	Manganese, Dissolved	2200	1500	700	29.5	297,200	31.8	112.6	2110	90	41.3	416100	4.1	20.3
C	W03	06-Oct-14	Manganese, Dissolved	2260	1750 J	510	30.2	304,500	22.6	84	2160	100	35.1	353800	4.4	19.1
C	W04	13-Oct-14	Manganese, Dissolved	2310 B	1970 B	340	26.8	270,000	14.7	49.7	2040 B	270	35.7	359700	11.7	52.5
C	W05	20-Oct-14	Manganese, Dissolved	2270	2030	240	29.2	294,600	10.6	38.2	1820	450	35.9	361600	19.8	88.1
C	W06	27-Oct-14	Manganese, Dissolved	2220	1650 J	570	27.7	278,800	25.7	86.1	1520	700	43.2	435500	31.5	164.8
C	W07	03-Nov-14	Manganese, Dissolved	2250	594	1656	28.8	290,300	73.6	260	1750 J	500	32	322600	22.2	87.2
C	W08	10-Nov-14	Manganese, Dissolved	2400	293	2107	27.9	280,900	87.8	320.4	1750	650	29.8	300300	27.1	105.6
C	W09	17-Nov-14	Manganese, Dissolved	2260	396	1864	27.9	281,100	82.5	283.5	1680	580	29.2	294300	25.7	92.3

C	W10	24-Nov-14	Manganese, Dissolved	2180	106	2074	27.0	271,700	95.1	305.2	1340	840	29.2	294300	38.5	133.7
C	W11	01-Dec-14	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Manganese, Dissolved	2200	232	1968	25.5	257,200	89.5	273.6	571	1629	27.8	279900	74	246.9
C	W00	15-Sep-14	Zinc, Dissolved	3500	62.5	3437.5	25.8	259,600	98.2	483.4	148	3352	33.8	340200	95.8	617.6
C	W01	22-Sep-14	Zinc, Dissolved	3800 J	30	3770	30.7	309,600	99.2	630.9	<10	3800	44.5	448200	100	921.8
C	W02	29-Sep-14	Zinc, Dissolved	4000	<10	4000	29.5	297,200	100	643.2	279	3721	41.3	416100	93	837.7
C	W03	06-Oct-14	Zinc, Dissolved	3970	102	3868	30.2	304,500	97.4	636.7	<10	3970	35.1	353800	100	759.6
C	W04	13-Oct-14	Zinc, Dissolved	4000	53	3947	26.8	270,000	98.7	576.6	59.4	3940.6	35.7	359700	98.5	766.8
C	W05	20-Oct-14	Zinc, Dissolved	4160	69.3	4090.7	29.2	294,600	98.3	651.1	65.7	4094.3	35.9	361600	98.4	801.2
C	W06	27-Oct-14	Zinc, Dissolved	4120	47.9	4072.1	27.7	278,800	98.8	614.9	46.9	4073.1	43.2	435500	98.9	959.1
C	W07	03-Nov-14	Zinc, Dissolved	3790	54	3736	28.8	290,300	98.6	586.5	91.7	3698.3	32	322600	97.6	645.1
C	W08	10-Nov-14	Zinc, Dissolved	4230	<10	4230	27.9	280,900	100	643.3	49.4	4180.6	29.8	300300	98.8	679.1
C	W09	17-Nov-14	Zinc, Dissolved	3770	23.5	3746.5	27.9	281,100	99.4	569.8	48.8	3721.2	29.2	294300	98.7	592.3
C	W10	24-Nov-14	Zinc, Dissolved	3760	159	3601	27.0	271,700	95.8	530	54.5	3705.5	29.2	294300	98.6	589.8
C	W11	01-Dec-14	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Zinc, Dissolved	3900	106	3794	25.5	257,200	97.3	527.4	368	3532	27.8	279900	90.6	535.2

NOTES:

Non detects are reported as <RL and estimated as zero for calculations and graphing.
% = percent
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
B = Laboratory flag indicating blank contamination
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
g/day = grams per day
gpm = gallons per minute
H = horizontal
H Δ CONC = horizontal change in concentration
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
J = Laboratory flag indicating estimated value between the MDL and the laboratory RL.
MDL = method detection limit
NS = not sampled
OU = operable unit
ppm = parts per million
RDEFF = Rock Drain Effluent
RL = reporting limit
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
V = vertical
V Δ CONC = vertical change in concentration
W** = Week of Treatability Study Phase

Non detects are reported as <RL and estimated as 1/2 MDL for calculations and graphing.
The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.
The Aeration Cascade in the vertical treatment train was bypassed during W06-W08. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in previous monthly reports. The flow rates for W06-W08 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the vertical Biotreatment cell.

Table 16. Hydrogen Sulfide Gas (ppm)
Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

			H2S-01 (Aeration Channel Inlet)			H2S-02 (Access Road near Aeration Channel-South)			H2S-03 (Access Road near Aeration Channel-North)			H2S-04 (Access Road near Biotreatment Cell)			H2S-05 (Aeration Cascade Inlet)		
Phase	**Week**	**Week of**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**	**average**	**minimum**	**maximum**
C	W00	15-Sep-14	0.033	0	1.1	0.018	0	1.5	0.0024	0	0.2	0.000	0	0	0.002	0	0.4
C	W01	22-Sep-14	0.016	0	0.7	0.025	0	1	0.0000	0	0	0.000	0	0	0.003	0	0.4
C	W02	29-Sep-14	0.032	0	1.7	0.003	0	0.5	0.0000	0	0	0.007	0	1.1	0.004	0	0.7
C	W03	06-Oct-14	0.022	0	3	0.002	0	0.4	0.0000	0	0	0.004	0	0.7	0.006	0	0.6
C	W04	13-Oct-14	0.005	0	0.5	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W05	20-Oct-14	0.005	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W06	27-Oct-14	0.008	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W07	03-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W08	10-Nov-14	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W09	17-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W10	24-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W11	01-Dec-14	0.006	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.002	0	0.4
C	W12	08-Dec-14	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W13	15-Dec-14	0.008	0	0.7	0.000	0	0	0.0000	0	0	0.000	0	0	0.011	0	0.6

NOTES:
AC1EFF = Aeration Channel Effluent/Rock Drain Influent
AC2EFF = Aeration Cascade Effluent
BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent
C = Colonization
FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)
gpm = gallons per minute
HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent
OU = operable unit
ppm = parts per million
RDEFF = Rock Drain Effluent
SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent
SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent
SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent
W** = Week of Treatability Study Phase

Horizontal Wetland Treatment Train Summary

DEC 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

HSSF Wetland Train Report for December 2014
(Data from Nov 12 – Dec 11, 2014)

Overall Performance

The HSSF wetland is finally operating as designed, as cadmium, iron, manganese and zinc are removed to very low levels. The aeration cascade aerates water and the rock drain produces an effluent that should be acceptable for discharge in a full-scale system.

Settling Basin

Settling Basin No. 1 is well under design flows. Turbidity levels fluctuated during this reporting period (Figure 1): it normally varied between 5-15 NTU, but occasionally (1-2 times/month) exceeded these levels.

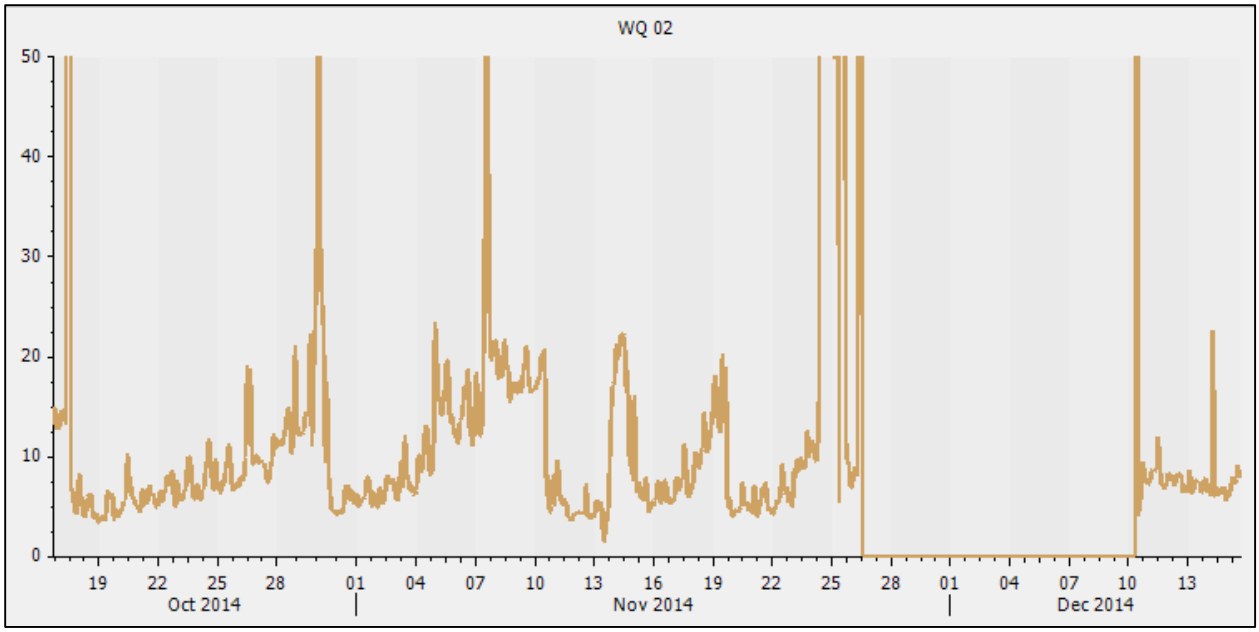


Figure 1. Turbidity measurements in SB1 effluent for October to December 2014.

Total suspended solids (TSS) decreased from average influent levels of 17.6 mg/L to average effluent levels of 9.8 mg/L, while total iron concentrations decreased from 6,365 µg/L to 1,390 µg/L. Dissolved iron concentrations also decreased from an influent of 3,105 µg/L to an effluent concentration of 530 µg/L.

Unlike in previous reports, the concentrations of several metals changed significantly in the settling basin. Total aluminum concentrations increased from 379 µg/L to 1,460 µg/L, while dissolved aluminum concentrations generally (there was one anomaly) decreased from 164 µg/L to 79 µg/L. This probably results from the addition of coagulant in the settling basin influent. Total copper concentrations decreased from 66.0 µg/L to 14.0 µg/L (80% decrease), but total zinc concentrations decreased by much less (11%). Manganese concentrations were unchanged.

Temperature remained consistently between 14 and 16 °C from mid-November to mid-December.

SF Wetland

The SF Wetland continues to provide marginal (<10%) metal removal. Total suspended solids (TSS) decreased from average influent levels of 9.8 mg/L to average effluent levels of 7.6 mg/L.

Total aluminum decreased slightly from average influent concentration of 1,460 µg/L to average effluent concentration of 1,402 µg/L, whereas total iron concentrations decreased from average influent concentration of 1,390 µg/L to average effluent concentration of 1,280 µg/L. None of the other metals of concern decreased significantly in the surface wetland.

HSSF Wetland

The HSSF Wetland showed good treatment performance during this reporting period. The ORP measured by sensors installed inside the matrix was consistently around -350 mV, which is optimal for sulfide generation and metal removal. Other parameters (DO, pH) were also optimal.

Both cadmium and zinc total concentrations decreased in the HSSF wetland, from average influent concentrations of 20.2 µg/L and 3,438 µg/L to average effluent concentrations of 1.6 µg/L and 701 µg/L, respectively. The removal rates were 92% and 80% for Total Cadmium and Total Zinc, respectively.

Dissolved cadmium concentrations were below detection limits in the wetland effluent, while zinc concentration averaged 208 µg/L, corresponding to >95% removal rates. As noted earlier, the difference between Total and Dissolved concentrations reflects the presence of colloidal sulfides in the wetland effluent.

Total copper decreased from average influent concentrations of 13.5 µg/L to average effluent concentrations of 6.6 µg/L, while dissolved copper decreased from 5.5 µg/L to 3.8 µg/L.

All the aluminum that flowed through the SFW was removed by the HSSFW. Influent concentrations averaging 1,402 µg/L were decreased to below detection limits for both Total and Dissolved metal concentrations.

Manganese concentrations decreased significantly in the HSSFW, from average influent concentrations of 2,188 µg/L to an average effluent concentration of 836 µg/L. Tthis represents a 62% removal rate, compared to the previously reported 10% removal rate. The consistent removal of manganese for four consecutive weeks indicates that this is not an artifact from sampling. We propose that manganese carbonate is the most likely insoluble product formed inside the wetland, very likely in the aerobic/anoxic transition zone near the wetland inlet.

Biological Oxygen Demand (BOD) in the HSSFW efluent was low, averaging 3.3 mg/L.

There were unexpectedly high concentration of Total Aluminum and Total Copper measured in the HSSFW inlet sampling point on November 25, but this was an anomaly that results from sampling.

The wetland effluent temperature has been trending downward compared to Settling Basin water temperatures, decreasing from 15 °C in late October to 11-12 °C in mid-December.

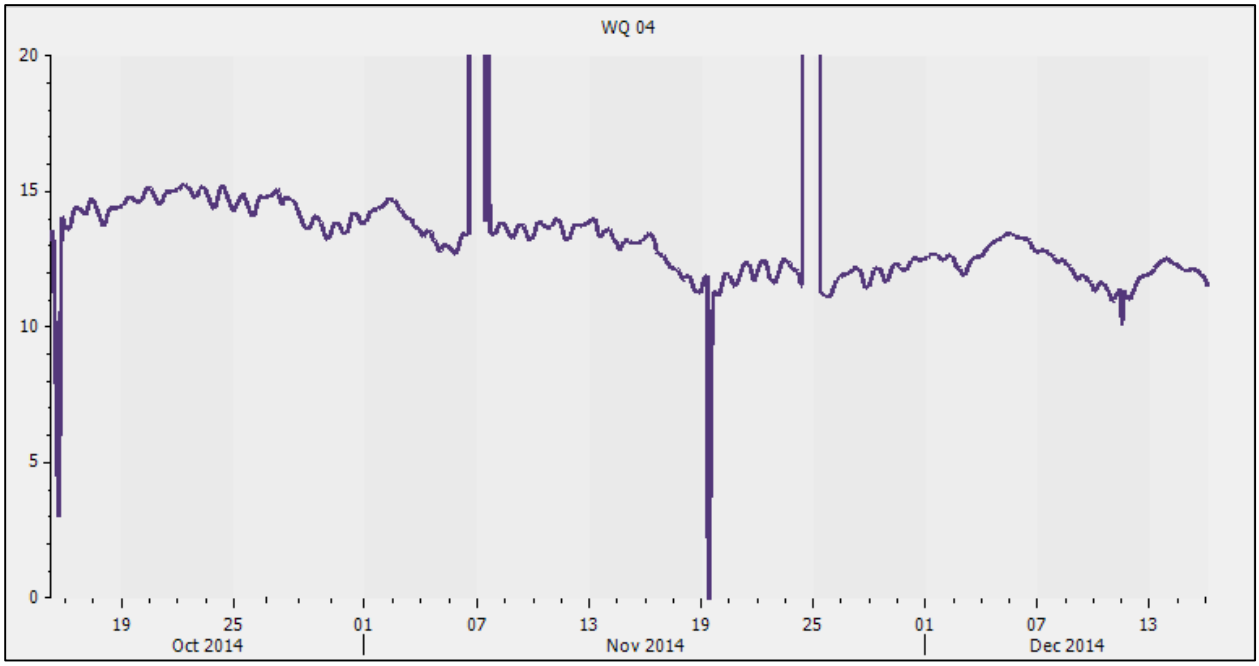


Figure 2. HSSF Wetland effluent temperature from October to December 2014.

Aeration Channel

The aeration channel has removed sulfide and re-aerated water steadily since improvements were made in October. On December 11, total sulfide concentrations decreased from 6.6 mg/L in the channel influent to 1.1 mg/L in its effluent.

There was additional metal removal in the aeration channel during this reporting period. Cadmium concentrations remained essentially unchanged, but total copper concentrations decreased by an average of 83%, while total zinc concentrations decreased by approxumately 25%. Manganese concentrations remained essentially unchanged. These results re-enforce the previous suggestion that the aeration channel removes colloidal metal sulfides.

The aeration channel removed some BOD, decreasing HSSFW average effluent concentrations from 3.3 to 2.75 mg/L.

Rock Drain

The rock drain is finally performing as designed. Manganese entering the drain is removed to low levels, from average influent concentrations of 1.0 mg/L to average effluent concentrations of 0.26 mg/L. Other metals were removed coincidentally with manganese, as previously observed. Average influent total cadmium concentrations decreased from 2.52 µg/L to 0.45 µg/L. Total copper concentrations decreased from 2.85 µg/L to <1 µg/L, whereas total zinc concentrations decreased from 995 µg/L to 240 µg/L.

ORP has been increasing steadily since November 17 and has reached a steady level of approximately 200 mV by the second week of December. Surprisingly, this has not been matched by a steady increase in dissolved oxygen: DO has remained between 1-3 mg/L during that time, whereas it was expected to increase to 5-8 mg/L. This suggests that oxygen may be consumed in the rock drain, possibly by the organic BOD that is present in the HSSFW effluent. Indeed, BOD levels decreased in rock drain, from average influent concentrations of 2.75 mg/L to average effluent concentrations of 1.25 mg/L.

The rock drain effluent temperature has been trending downward compared to HSSFW water temperatures, decreasing from 12-13 °C in late October to 9-10 °C in mid-December (Figure 3). This represents an average loss of 1 °C between these two units.

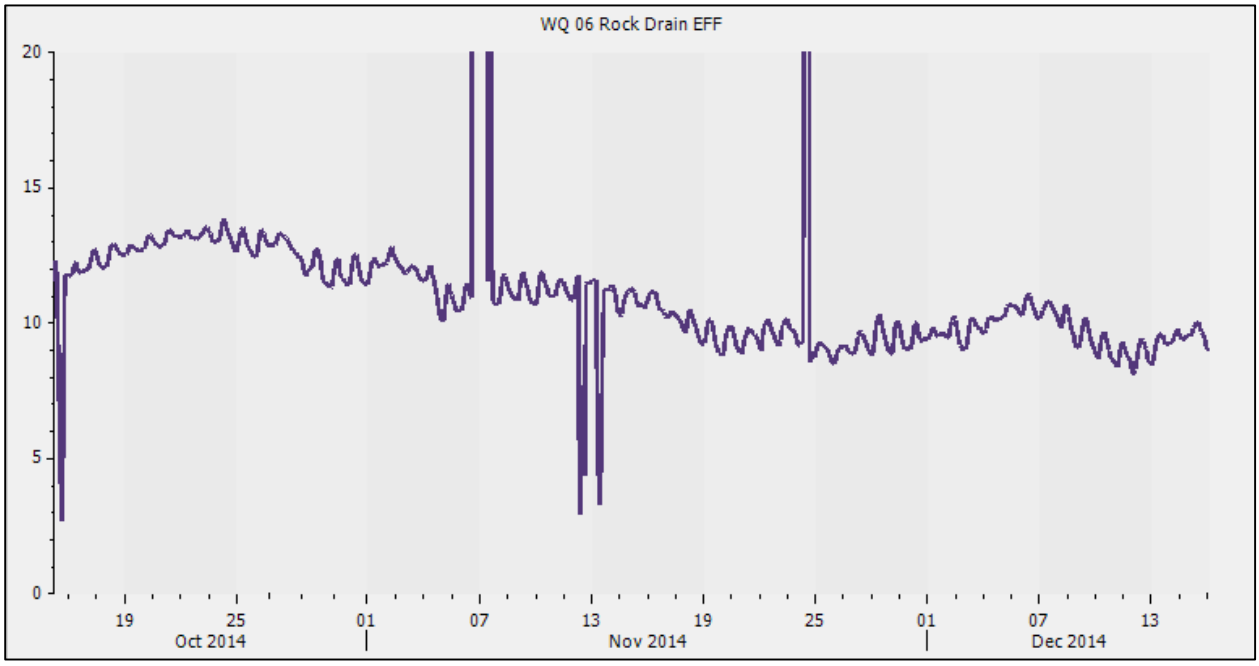


Figure 3. Rock drain effluent temperature from October to December 2014.

The problems with turbidity/suspended solids described in the last report have been largely resolved. TSS levels in rock drain effluent were below detection limits during this reporting period, except for the November 18 sampling, where they decreased from influent concentrations of 30 mg/L to 11 mg/L in the effluent.

Conclusions – HSSF Treatment Train

The HSSF treatment train is essentially performing as intended. Iron concentrations are decreased to design concentrations in the settling basin. The increased aluminum concentrations resulting from coagulant addition are completely removed in the HSSF wetland, along with most of the cadmium, copper and zinc. Surprisingly, manganese is also removed significantly in the wetland. The aeration channel now function as designed, removing BOD and sulfides and re-aerating the wetland effluent. Finally, the rock drain now removes manganese to < 0.25 mg/L. It also polishes the wetland effluent by removing residual BOD and decreasing cadmium, copper and zinc concentrations to very low levels.

Information is being gathered on the operating parameters (flows, pH, ORP, temperature) and will later be used to determine their relationship with treatment performance.

Vertical Wetland Treatment Train Summary

DEC 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Rico Vertical Wetland Treatment Train Report for December 2014
(Data from November 12 to December 11, 2014)

Settling Basin No. 2

Settling Basin No. 2 (SB No. 2) performance was similar to previously reported results. Turbidity decreased from an average influent level of 36 NTU to an average effluent level of 6.4 NTU. Average heat loss across SB No. 2 was 2.1 °C. No significant changes were observed in any other field parameters.

Total metals removal was similar to previously reported results. Total copper, iron and lead concentrations decreased markedly, with respective average removal efficiencies of 76.5%, 75.4% and 78.1%. Insignificant removal was observed for cadmium, manganese, nickel and zinc. Total aluminum concentrations increased by 194%, presumably due to the presence of residual aluminum chlorohydrate coagulant. Influent and effluent arsenic results were below laboratory detection limits.

Biotreatment Cell

Total aluminum concentrations decreased from an average influent concentration of 1,059 µg/L to below laboratory detection limits. Total cadmium concentrations decreased from an average influent concentration of 21.2 µg/L to an average effluent concentration of 0.4 µg/L. Total zinc concentrations decreased from an average influent concentration of 3,748 µg/L to an average effluent concentration of 576 µg/L. Total manganese concentrations decreased from an average influent concentration of 2,280 µg/L to an average effluent concentration of 1,410 µg/L. Influent and effluent total arsenic results were below laboratory detection limits.

Dissolved cadmium concentrations decreased from an average influent concentration of 20.6 µg/L to below laboratory detection limits. Dissolved zinc concentrations decreased from an average influent concentration of 3,542 µg/L to an average effluent concentration of 114 µg/L. Dissolved manganese concentrations decreased from an average influent concentration of 2,220 µg/L to an average effluent concentration of 1,417 µg/L. Influent and effluent dissolved arsenic results were below laboratory detection limits.

Effluent BOD, TOC and total sulfide concentrations averaged 8.3 mg/L, 2.4 mg/L and 7.9 mg/L, respectively.

Aeration Cascade

Total and dissolved concentrations of all metals were not significantly different from the average influent concentrations. Effluent BOD, TOC and total sulfide concentrations averaged 4.3 mg/L, 2.4 mg/L and 1.3 mg/L, respectively.

Conclusions and Observations – Vertical Wetland Treatment Train

VWTT metals removal performance was within design expectations at design flow rates. Two notable observations were made in regards to metals removal. The first is that manganese removal in the biotreatment cell steadily increased over the reported period, increasing from 27% removal on November 6 to 73% removal on December 10. The removal rate on December 10 is much higher than expected under anaerobic conditions. It is currently hypothesized that precipitation as manganese carbonate is occurring in the aerobic/anaerobic transition zone. A similar trend was observed in the HWTT HSSFW and it will be monitored closely in both treatment trains in the upcoming months.

The second observation was that dissolved zinc increased markedly in the biotreatment cell effluent in the December 10 sampling results. Dissolved zinc increased from a previous average of 47 µg/L to 380 µg/L. Similar results were observed in the HWTT HSSFW. It cannot be determined from this single data point if this is an isolated anomalous result or the start of a long-term trend.

Wetland Plant Update

DEC 2014

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

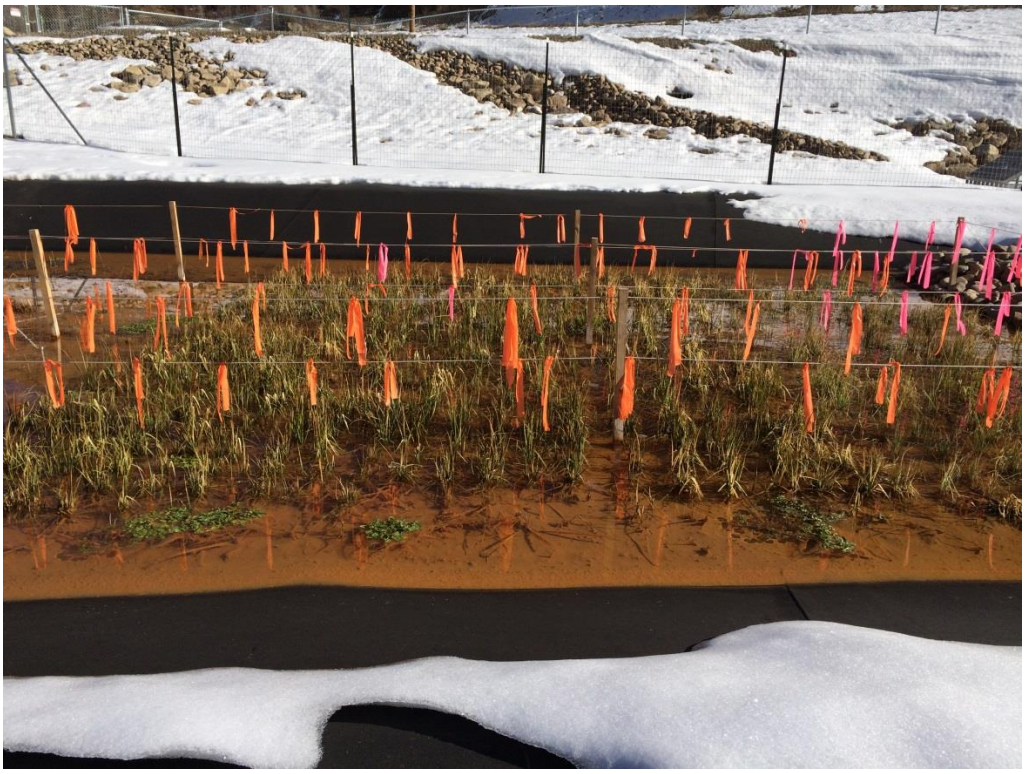
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

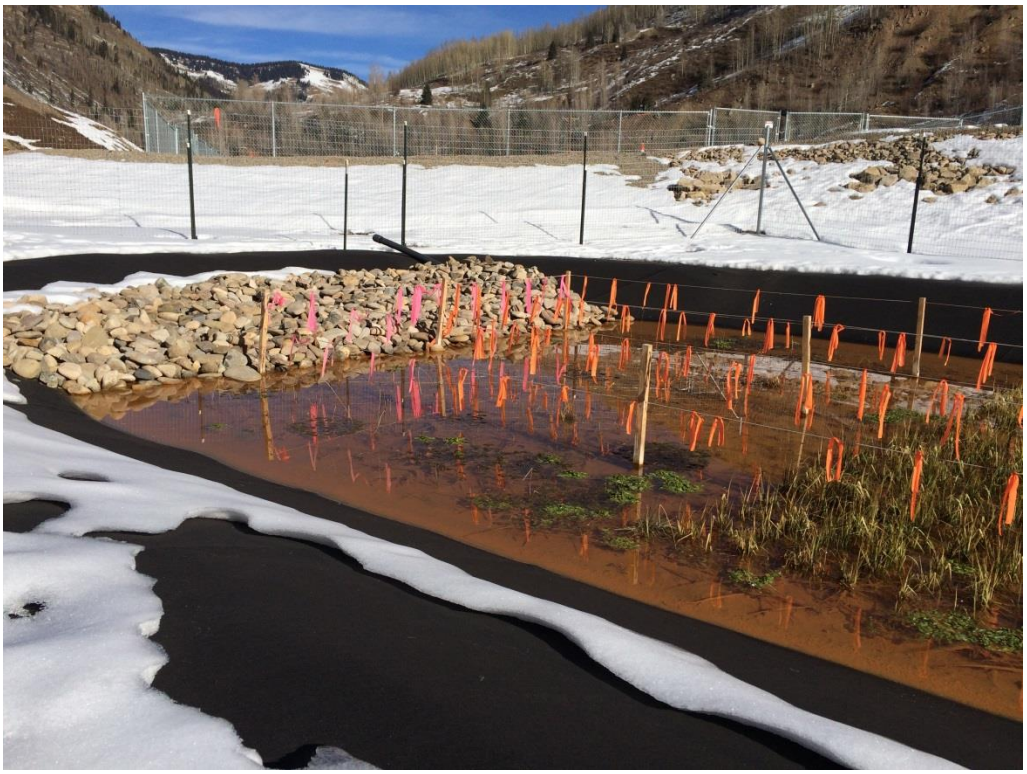
December 2014 Monitoring

Photograph 1: SF Wetland with Planted Bulrush, Sedge and Rush – Looking South on December 10, 2014

Photograph 2: SF Wetland with Bulrush, Sedge, and Rush – Looking West on December 10, 2014



Photograph 3: SF Wetland Looking East on December 10, 2014



Photograph 4: SF Wetland Looking Northeast on December 10, 2014

Photograph 5: HSSF Wetland with Establishing Wetland Plants – Looking South on December 10, 2014

Photograph 6: HSSF Wetland – Location of Sampling Points Comparing Vegetation Success in Scoured Bare Area with Snow Covered Area (either side of middle FRP) on December 10, 2014

Photograph 7: HSSF Wetland – Location of Sampling Point in Matrix Comparing Vegetation Success in Scoured Bare Area with Snow Covered Area on December 10, 2014

Photograph 8: HSSF Wetland – Location of Sampling Point in Matrix Comparing Vegetation Success in Scoured Bare Area with Snow Covered Area on December 10, 2014

Photograph 9: HSSF Wetland – Location of Sampling Point in Northern Soil Test Strip Reviewing Vegetation Success in Snow Covered Area on December 10, 2014

Photograph 10: HSSF Wetland – Location of Sampling Point in Northern Soil Test Strip Reviewing Vegetation Success in Snow Covered Area on December 10, 2014